

Spring 2014

Carbon Fibers Derived From PAN/Bio-based Bicomponent Precursor

Jing Jin
Clemson University

Follow this and additional works at: https://tigerprints.clemson.edu/grads_symposium



Part of the [Biochemical and Biomolecular Engineering Commons](#)

Recommended Citation

Jin, Jing, "Carbon Fibers Derived From PAN/Bio-based Bicomponent Precursor" (2014). *Graduate Research and Discovery Symposium (GRADS)*. 110.
https://tigerprints.clemson.edu/grads_symposium/110

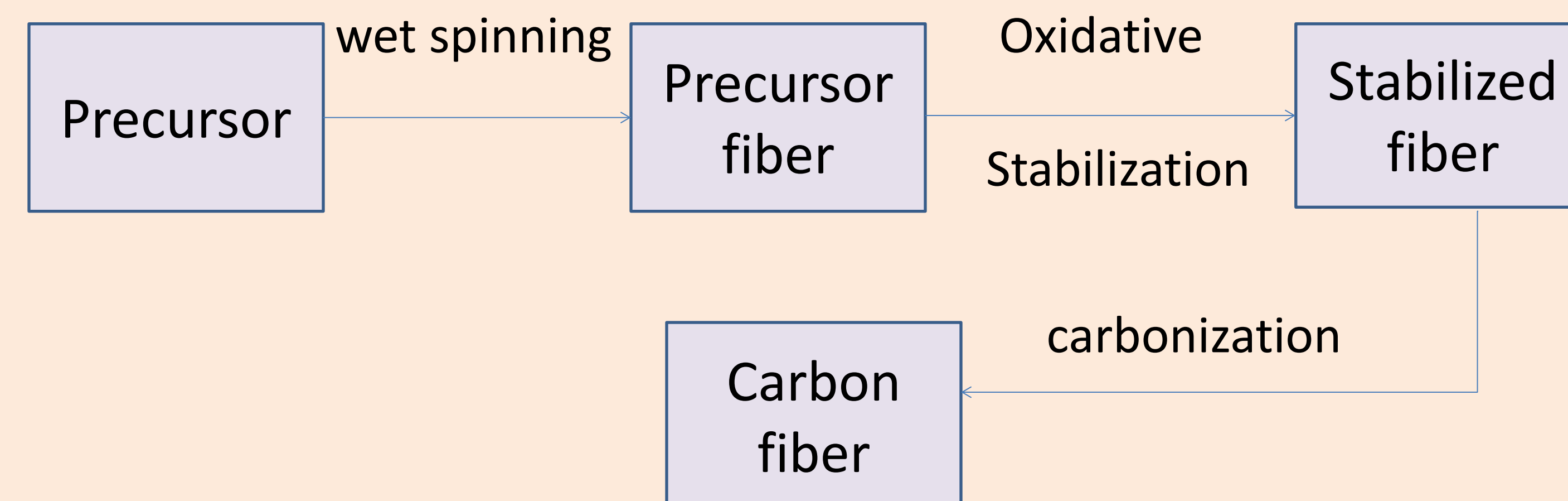
This Poster is brought to you for free and open access by the Research and Innovation Month at TigerPrints. It has been accepted for inclusion in Graduate Research and Discovery Symposium (GRADS) by an authorized administrator of TigerPrints. For more information, please contact kokeefe@clemson.edu.

Carbon Fibers Derived From PAN/Bio-based Bicomponent Precursor

Jing Jin; Advisor: Prof. Amod Ogale; Department of Chemical and Biomolecular Engineering, Clemson University

Introduction

- Poly(acrylonitrile) based carbon fiber dominates over 90% of carbon fiber market due to the high tensile strength



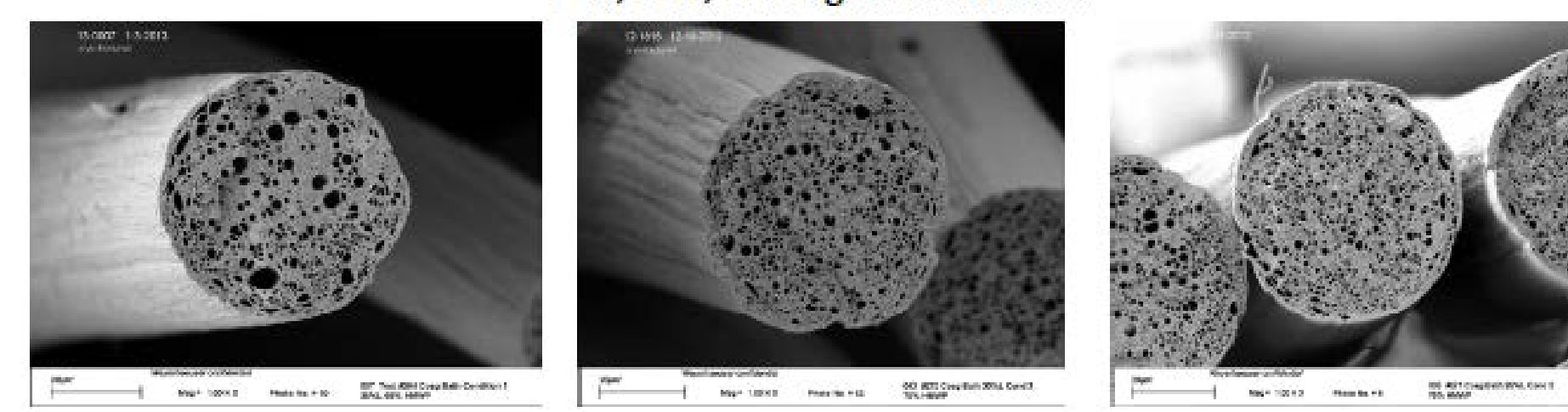
- However, the high price of PAN limits the widespread use of carbon fiber
- To reduce the cost of precursor, bicomponent precursor (PAN with bio-based material, such as lignin) is studied in this project

Partially Bio-based PAN-lignin Blend as Carbon Fiber Precursor [1]

- Zoltek and Weyerhaeuser has developed lignin/PAN polymer blend precursor for carbon fiber by wet spinning



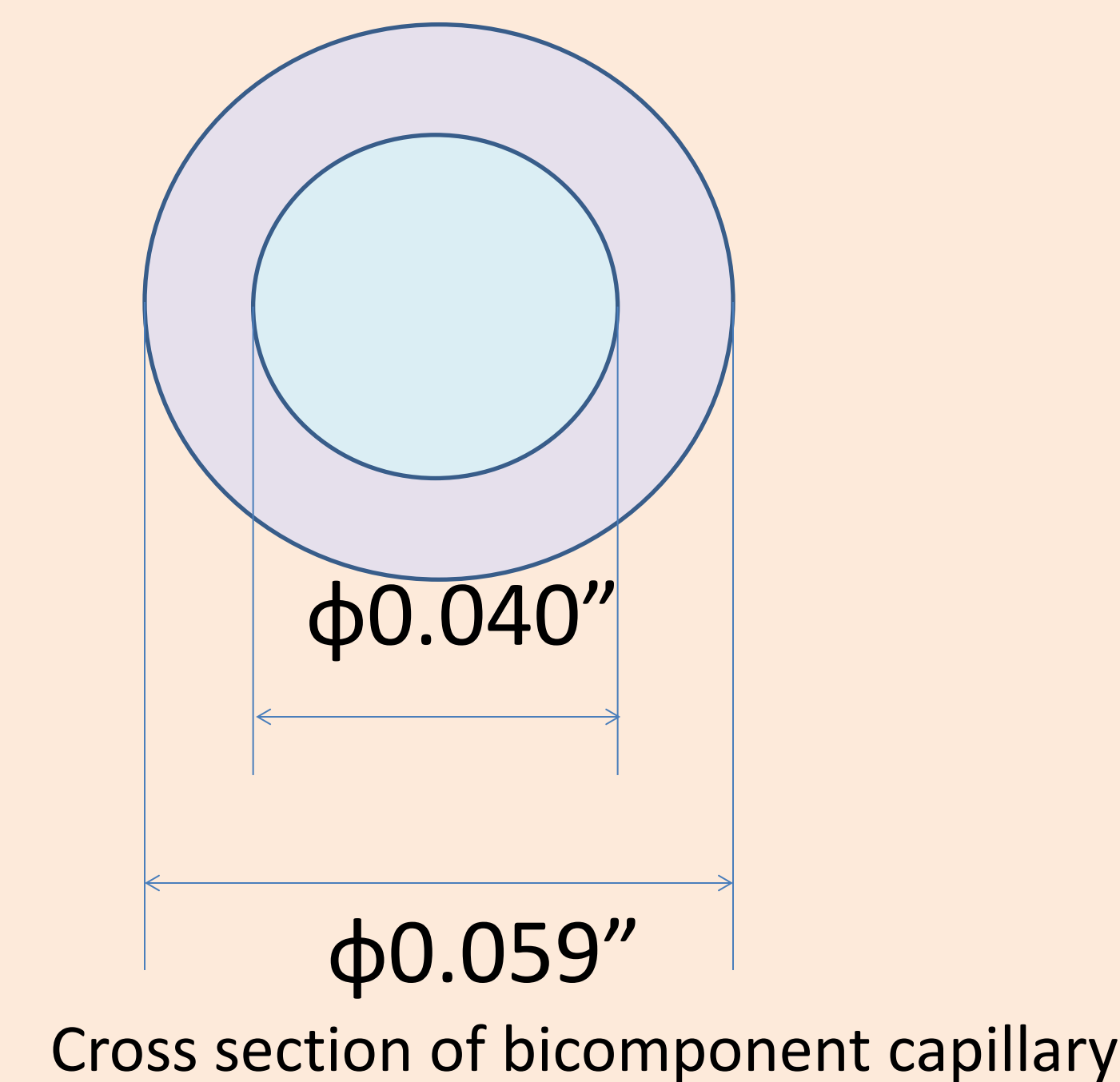
35%, 30%, 25% Lignin with HMWP



- 35% lignin/PAN precursor resulted in the highest and most uniform tensile property of 1.7Gpa
 - Limitation: Lignin particles result in morphologies with macro-voids; these were not successful for converting to carbon fiber
- $\frac{\text{tensile strength of 35\%L/P fiber}}{\text{tensile strength of 100\% PAN fiber}} \approx 0.61 \approx \text{PAN content}$
- Lignin dose not provide any strength in resulting carbon fiber

Wet Spinning

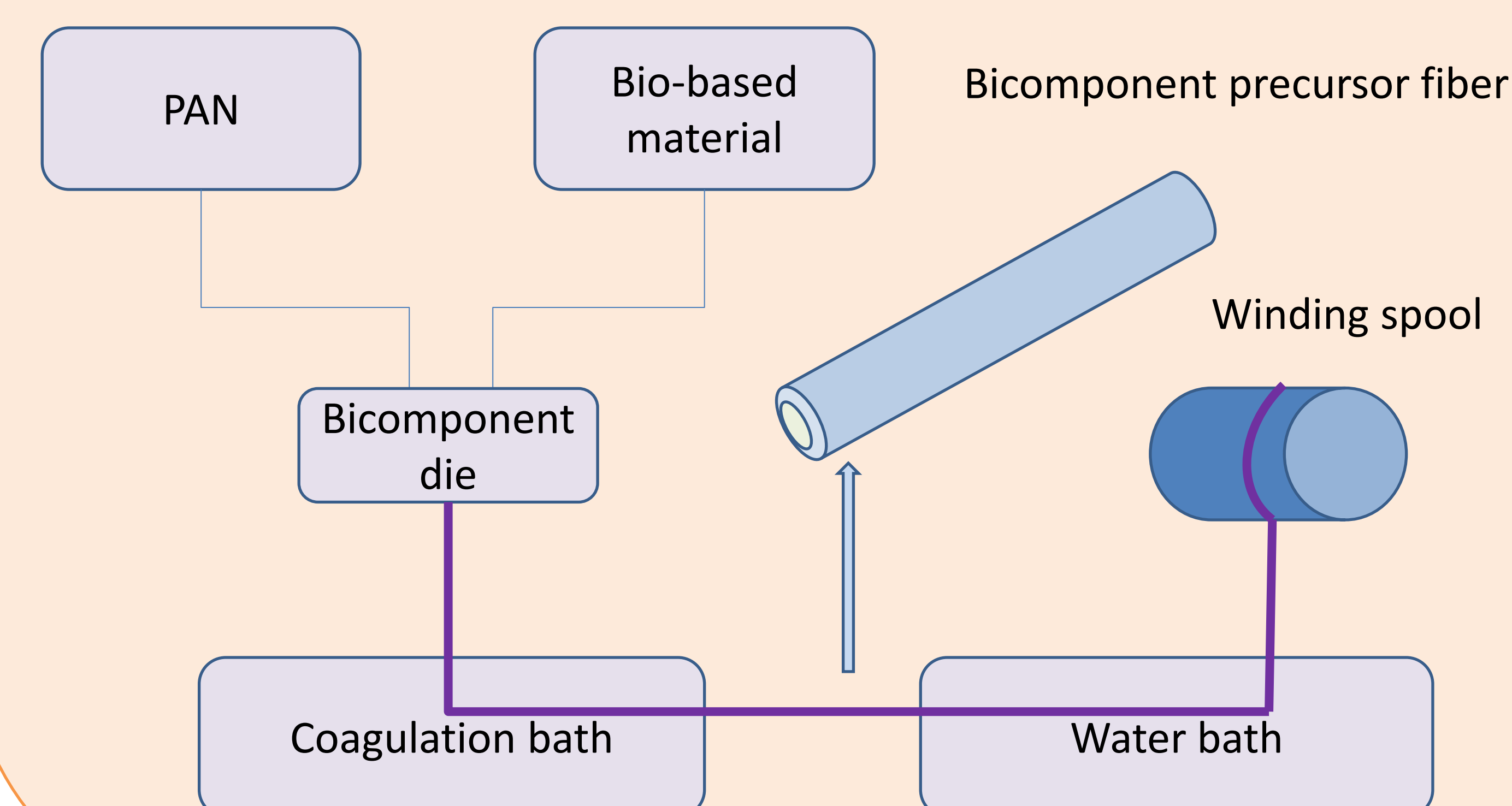
- Polymers are dissolved in solvent to form solution
- Fiber is formed by using coagulant to extract solvent from polymer
- PAN--sheath, Bio-based material--core



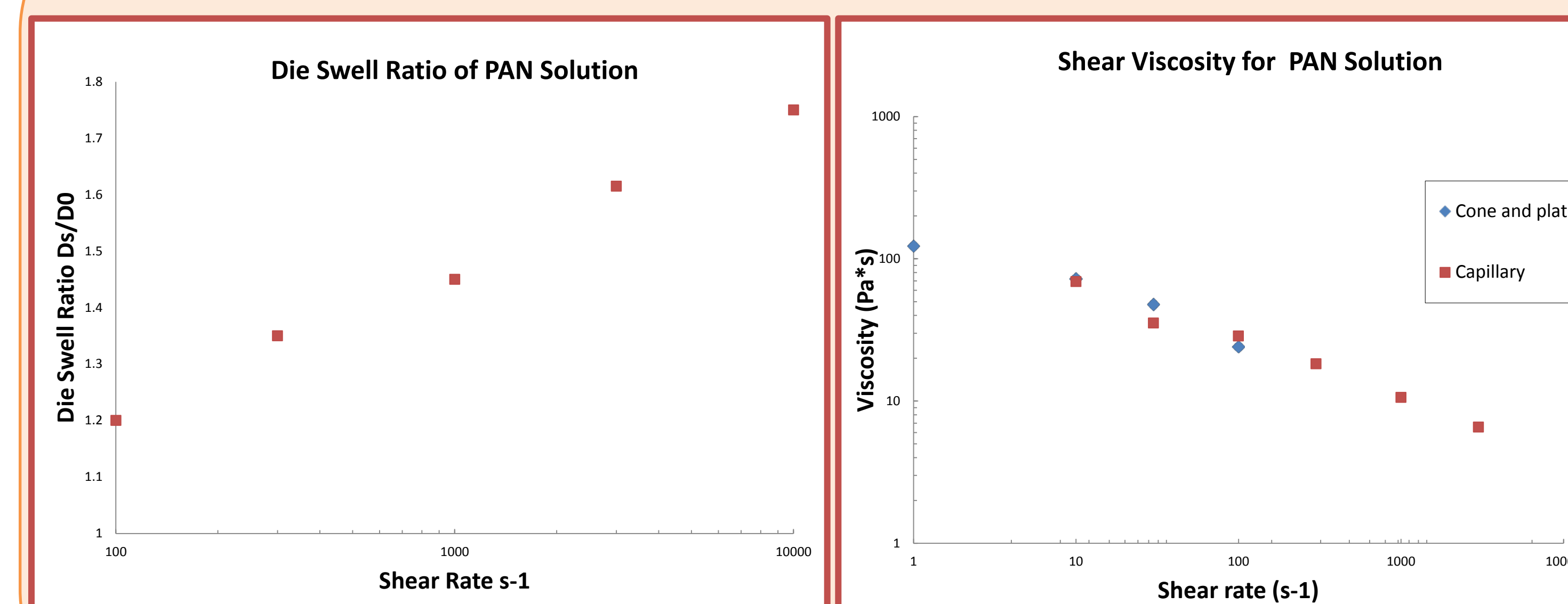
Cross section of bicomponent capillary



Bicomponent die



Viscoelasticity of PAN Solution



Stabilization and Carbonization

- Thermal oxidative stabilization is accomplished by heating precursor fibers in air at 200 to 400 °C
- Tension must be applied to keep molecular orientation during stabilization
- Carbonization occurs at temperature over 1000 °C in an inert environment
- Stabilized fibers are hung on a graphite rack with tungsten weight hooked below



Stabilization furnace



High temperature furnace

Future Work

- Test spinnability of lignin
 - Rheology study
- Produce bicomponent carbon fiber
- Characterization of resulting carbon fiber
 - Mechanical properties (tensile strength and Young's modulus)
 - Physical properties (cross sectional shape with SEM and crystallite structure with WAXD)
- Property modification
 - UV assisted stabilization